REMARKS

Status of the Claims

Claims 1-46 remain pending in the present application, Claims 45 and 46 having been added and Claims 1 and 20 having been amended to more clearly define the subject matter.

Summary of Telephone Interview With Examiner

On Thursday May 8, 2008, applicants' attorney (Sabrina MacIntyre, Registration No. 56,912) conducted a brief telephone interview to discuss the current Final Office Action with Examiner Senfi in view of the Sullivan references and the proposed amendments that had been faxed at an earlier date.

Applicants' attorney briefly summarized the nature of the amendments and how the language of Claim 1 distinguishes over the cited art. More specifically, with respect to the proposed amendment for independent Claim 1 step (a), applicants' attorney explained that they were trying to clarify the definition of a large depth of focus display, by reciting that in such a display, "all elements in the image are initially displayed at an optical focus level that is substantially the same for all elements." Applicants' attorney also briefly summarized how the Sullivan references, in contrast, teach a narrow depth of focus display (as discussed in greater detail below). Examiner Senfi indicated that this definition of a large depth of focus display still appeared to be too broad and noted that it would be helpful to make additional clarifying amendments to explain what is meant by this term, so that it might be clear how the claims distinguish over the cited art.

Applicants' attorney and Examiner Senfi discussed adding additional language to the claim, for example, to indicate that such a display presents an unnatural viewing condition to a user. Although no agreement regarding the patentability of the claims was reached during the telephone interview, the Examiner indicated that a clearer definition of this term would be very helpful in advancing prosecution of this case and invited applicants' attorney to call him when the Response is submitted.

Applicants' attorney would like to again thank Examiner Senfi for his time and willingness to discuss these issues during the Telephone Interview.

Allowable Subject Matter

Claims 42 and 43 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Accordingly, new Claim 45 has been added that incorporates the recited subject matter of Claims 7, 8, 12, and 42 into independent Claim 1.

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Similarly, new Claim 46 has been added that incorporates the recited subject matter of Claims 7, 8, 12, and 43 into independent Claim 1. Both of these new claims should thus be patentable.

Claims Rejected Under 35 U.S.C. § 103(a)

Claims 1, 2, 5-10, 15, 17, 19-21, 24-29, 34, 36, 38, and 41 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0163482 (Sullivan, hereinafter referred to as "Sullivan1"), in view of U.S. Patent Publication No. 2003/0086062 (Shevlin), and further in view of U.S. Patent Publication No. 2003/0067421 (Sullivan, hereinafter referred to as "Sullivan2").

Claims 3, 16, 18, 22, 35, 37 and 39-40 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Sullivan1, in view of Shevlin, in view of Sullivan2, and further in view of U.S. Patent No. 6,449,309 (Tabata).

Claims 4, 11, 13, 14, 23, 30 and 32-33 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Sullivan1, in view of Shevlin, in view of Sullivan2, and further in view of U.S. Patent No. 6,133,944 (Braun et al., hereinafter referred to as "Braun").

Claims 12, 31, and 44 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Sullivan1 in view of Shevlin, in view of Sullivan2, and further in view of U.S. Patent No. 5,954,414 (Tsao).

Applicants respectfully disagree with the above rejections for at least the following reasons.

In the interest of reducing the complexity of the issues for the Examiner to consider in this response, the following discussion focuses on independent Claims 1 and 20. The patentability of each remaining dependent claim is not necessarily separately addressed in detail. However, applicants' decision not to discuss the differences between the cited art and each dependent claim should not be considered as an admission that applicants concur with the Examiners conclusion that these dependent claims are not patentable over the disclosure in the cited references. Similarly, applicants' decision not to discuss differences between the prior art and every claim element, or every comment made by the Examiner, should not be considered as an admission that applicants concur with the Examiner's interpretation and assertions regarding those claims. Indeed, applicants believe that all of the dependent claims patentably distinguish over the references cited. In any event, a specific traverse of the rejection of each dependent claim is not required, since dependent claims are

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patentable for at least the same reasons as the independent claims from which the dependent claims ultimately depend.

Patentability of Independent Claim 1

Significant differences exist between the recited subject matter and the cited art because the cited art does not teach or suggest a large depth of focus display that simulates an unnatural viewing condition, but instead teaches a narrow depth of focus display. Step (a) recites (emphasis added):

> displaying an image to a viewer on a large depth of focus display wherein all elements in the image are initially displayed at an optical focus level that is substantially the same for all elements, thereby simulating an unnatural viewing condition, since elements viewed at different depths should naturally appear at different focus levels

Applicants have amended step (a) to clarify that the viewer is viewing the image on a *large depth of focus display,* which simulates an unnatural viewing condition with all elements at substantially the same optical focus level. Before explaining where support is provided in the specification for these amendments, it may be helpful to provide some background information in order to help distinguish applicants' *large* depth of focus display from the cited art's *narrow* depth of focus display. The specification explains that the human eye has a limited Depth of Focus (DOF) and that when viewing a real scene in which objects are at different depths, not every object in the scene will be observed in focus at the same time. Accordingly, the focus of the observer's eyes adjusts to bring objects into focus (specification, page 2, lines 4-7) when the observer's gaze is directed at objects at different depths in the real scene. More specifically, our eyes monitor blur feedback and make corrections, and this process of ***natural*** viewing and focusing is known as closed-loop accommodation (specification, page 3, lines 1-4) because the blur feedback loop is intact or "closed." In contrast, we can artificially increase the DOF of our eyes, for example, by viewing a scene through a small pinhole, and by doing so, **both distant and near objects are observed in focus at the same time** (specification, page 3, lines 7-9). By viewing the scene through a pinhole, blur feedback is decreased or substantially removed, which produces an open-loop accommodation (specification, page 3, lines 7-11). FIGURE 1 illustrates a virtual retinal display (VRD), which is an example of a large DOF display (specification, page 9, lines 15-16). All the rays projected from the VRD converge at a small exit pupil, so the images it projects on the observer's retina have a large DOF (specification, page 9, lines 23-25). Since the display creates the equivalent of a "pinhole" aperture at its exit pupil, it projects a clear image on the back of a viewer's retina that is independent of the

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degree of a viewer's accommodation (specification, page 9, lines 26-28), and in which all objects at different depths in a scene appear to be in focus at the same time. It is important to note that since the image viewed by the eye is provided with a large DOF, the light rays that form the image are in focus on the retina in both views 20 and 40 (specification, page 9, line 31-page 10, lines 2). Because all planes in which objects in a scene are observed with such a display remain in focus throughout the range of accommodation of the viewer's eye, the viewer is provided with little or no feedback to the accommodative system, giving rise to open-loop accommodation (specification, page 10, lines 2-4). And, as described above, open-loop accommodation lacks the blur feedback, which is the condition described in step (a) of Claim 1 in regard to the display of an image on a large depth of focus display. All elements in the image are thus initially displayed at substantially the same optical focus level regardless of their depth in the image, because the image has been displayed on a large depth of focus display. Thereby, the user is caused to have an open-loop accommodation that is unnatural or artificial, as compared to a closed-loop accommodation, which is a natural viewing condition when a real scene is observed by the eye.

In contrast, Sullivan2 does NOT teach a large depth of focus display, but instead teaches a narrow depth of focus display. The Examiner asserts that although Sullivan1 does not explicitly mention a large depth of focus display (page 4 of Office Action dated January 28, 2008), Sullivan2 teaches a large depth of focus display and cites to page 2, paragraphs 0014-0017 of Sullivan2 in support of this assertion. Applicants respectfully disagree and summarize below why Sullivan2 actually teaches a narrow depth of focus display. Paragraphs 0014 - 0016 from Sullivan2 are reproduced below to aid in this discussion.

> [0014] In the prior art multi-planar volumetric display system of FIG. 1, the optics 22 of the projection lens is set to a fixed focus such that the inherent depth of focus is capable of producing an adequately resolved image over some range of image distances. As known in the art, the depth of focus is a function of the f-number of the optical projection system. For a simple lens, the f-number is the focal length of the lens divided by the effective diameter of the lens (or linear aperture). Thus, the depth of focus increases with increasing f-number. *As a consequence, a multi-planar volumetric display system as shown in FIG. 1 requires an optical projection system having a relatively high f-number in order to provide a sufficiently large depth of focus to span the entire extent of the MOE device 32 along the optical axis.* However, **the amount of light that an optical system can collect from available high brightness light sources decreases with increasing f-number and this consequently limits the brightness of the image that can be obtained from a**

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multi-planar volumetric display system having the exemplary arrangement shown in FIG. 1. (Emphasis added.)

[0015] Hence, in prior art multi-planar volumetric display systems, there is an inherent design tradeoff that is accommodated between the need for a sufficient depth of focus to cover the entire MOE device 32 within the resolution requirements designed for the display and the desire to project high amounts of light for high image brightness.

[0016] For the foregoing reasons, there is a need for a rapidly adjustable variable focusing projection system that can provide a focused image over a range of image distances which span the extent of the multiple optical element device, thereby making it possible to employ relatively low f-number optics and high brightness light sources to produce bright images.

Sullivan2 is describing prior art that is directed toward a large depth of focus projector. However, it is important to understand that a large depth of focus projector is VERY different from a large depth of focus display. Sullivan2 describes projecting an image on a series of physical planes that are at different depths, or onto a plurality of LCDs (for example optical elements 36-42 of Figure 1) at different depths in its multi-planar volumetric display system 10. This system uses one projector 20 to project images sequentially onto the screens or LCD panels at different depths. Sullivan needs a projector that can simultaneously project the different components of the image onto different screens in focus, without having to change anything in the physical configuration of the display system, as highlighted in the italic portion above. But, as highlighted in the bold font portion above, using a small aperture to project the component of the images onto the different screens, would dramatically limit the amount of light available to create the images. This solution is the design trade-off that is indicated in paragraph 0015. So instead, the solution used by Sullivan2 is to employ a variable focus projector that can physically be modified to sequentially focus on each plane (as described in paragraph 0016).

However, the Sullivan2 system produces a narrow depth of focus display, although it uses a large depth of focus projector to project images onto the screens at different depth planes. Each plane in Sullivan's system is a scattering medium, so that the light projected onto each plane scatters in all directions and as a result, the planes at different depths in the Sullivan system are at different focus levels – not at the same focus level. Sullivan2 thus describes a system in which the observer is provided a narrow depth of focus view, since the viewer's eyes will have to focus differently at the different plane depths to see the image components on the different planes in focus. This system of

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Sullivan2 thus creates a narrow depth of focus view for the observer, since the light from each plane fills or overfills the entrance pupil of the eye. In contrast, if all light passing through a region of space relative to a scene enters the observer's eye in a beam that is smaller than the pupil, as is the case when observing a scene through a pinhole, then the display is a large depth of focus display in which all elements are in focus at the same time, even though at different focus depths.

A large depth of focus display is what is generated *initially* in step (a), in other words, before blur feedback is applied, thereby simulating an unnatural or artificial viewing condition. When the image elements are presented to the viewer on the large depth of focus display, they all appear to reside at the same physical viewing distance, which is very different from Sullivan2, wherein the different planes of screens include image elements at different multiple physical viewing distances. Then in step (b), an accommodation is determined. Applicants have clarified that this happens when a gaze of the viewer is directed toward an element in the image (specification, page 14, lines 21-22). Then blurring is added, as recited in step (c). The specification, explains for example, if the viewer's eye accommodates to a distance of five meters, the computing device leaves objects near the five meter point in the scene unblurred, but blurs other objects that are at different depths in the scene, in proportion to their distance from the five meter focus point. The computing device outputs the selectively blurred image to the large DOF display (specification, page 14, line 28-page 15, line 2). What is now presented to a user is a simulation of a natural or artificial viewing condition in which all objects are NOT simultaneously in focus. Accordingly, the rejection of independent Claim 1 under 35 U.S.C. § 103(a) should be withdrawn because the cited art does not teach or suggest all of the recitation of Claim 1.

Since dependent claims inherently include all of the recitation of the independent claims from which they ultimately depend, for at least the same reasons as noted above in connection with independent Claim 1, the rejection of dependent Claims 2-19, and 42 -44 should also be withdrawn.

Patentability of Independent Claim 20

Independent Claim 20 is directed toward a system for more accurately conveying depth in an image. The Examiner has rejected Claim 20 for reasons similar to those given for the rejection of Claim 1. Applicants have amended this claim in a manner similar to that by which they amended Claim 1.

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Thus, applicants respectfully submit that for the reasons given above in their traversal of the rejection of Claim 1, significant differences exist between the recited subject matter and the cited art, because the cited art does not teach or suggest a large depth of focus display. Accordingly, the rejection of independent Claim 20 under 35 U.S.C. § 103(a) should be withdrawn because the cited art does not teach or suggest all of the recitation of Claim 20.

Since dependent claims inherently include all of the recitation of the independent claims from which they ultimately depend, for at least the same reasons as noted above in connection with independent Claim 20, the rejection of dependent Claims 21-41 should also be withdrawn.

Conclusion

In consideration of the amendment to the claims and the Remarks set forth above, it is applicants' position that all claims in the current application are patentable over the art of record. The Examiner is thus requested to pass this case to issue without further delay. In the event that any other issues remain, the Examiner is invited to telephone applicants' attorney at the number listed below.

Respectfully submitted,

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